J. P. Donnell S.J.

S. J. B

A. M. D. G.

American Association of Jesuit Scientists

Eastern States Division

PROCEEDINGS

of the

ELEVENTH ANNUAL MEETING

August 11, 12, 13, 1932

Holy Cross College, Worcester, Mass.

Published at

LOYOLA COLLEGE

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Bulletin of American Association of Jesuit Scientists

EASTERN STATES DIVISION

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Bausch and Lomb Optical Company, Rochester, N. J.
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Laboratory No. 4 O'Kane Building

Please send in the abstracts of papers to the Secretary
Closing date: September 15, 1932

PROCEEDINGS

FIRST GENERAL SESSION

The eleventh annual meeting of the American Association of Jesuit Scientists, Eastern States Division, was held at Holy Cross College, Worcester, Massachusetts, on August 11, 12 and 13, 1932. The General meeting was called to order by Rev. C. E. Shaffrey, at 7:45 P. M. in the Biology Lecture Hall.

The minutes of the previous meeting were accepted as read. The chairman then appointed the following committees:

Committee on Resolutions:

Rev. J. M. Kelley
Rev. J. P. Merrick
Mr. A. A. Coniff

Committee on Nominations:

Rev. R. B. Schmitt
Rev. E. J. Kolkmeyer
Rev. W. G. Logue

Father Schmitt then made the proposal, that out of regard for the zeal shown by the late Father George L. Coyle for the prosperity of this Association, that each priest of the Association say one mass and each scholastic one pair of beads for the repose of his soul. This proposal met with the approval of all and was turned over as part of the business of the Resolutions Committee, to the chairman of that committee.

PRESIDENTIAL ADDRESS

Human Heredity

It is much more difficult to collect facts in regard to human heredity than it is in regard to laboratory animals.

Because of the length of human life investigations cannot be carried very far or followed for any more than one or two generations. Then too, it is difficult to learn many of the facts that are needed to complete a study of the transmission of some character. This is due to the fact that we must be able to ascertain those facts either from scientific records of the past and these are very few and are in most instances incomplete. Geneologies are few and these too may be lacking in the information sought. Again it is difficult to distinguish between the results of heredity and those produced by environment.

However the task is being gradually lightened by access to data which are being constantly collected by scientific investigators, and also by the records of public institutions which are now made with the in-

tention of furnishing information useful in the study of heredity and eugenics.

Studies indicate that the mechanism is practically the same in the human as in other animals and in plants. We know that the chromosomal mechanism is the active agent in transmission in animals and plants, and as we have the same chromosomal mechanism, that is essentially the same, we can well believe that the process of transmission of characters from parent to offspring follows the same laws we find to hold for experimental animals and plants. In the human cells there are twenty-three pairs of autosomes and an additional pair of X chromosomes in the female, and an additional X chromosome together with a Y chromosome in the male. The X chromosomes are concerned with the determination of sex.

It has been possible to determine many of the common characters in the human, as eye-color, color and character, as well as defects of structure or abnormalities in the functions of organs, etc.

To consider a few of these. Eye color we know is due to presence of brown pigment in the iris. If the amount of pigment is considerable the eyes will be brown, but the color will shade off toward blue as the amount of pigment decreases, hence blue eye color is not an allelomorph of brown but rather the absence of brown pigment. Study has shown that brown is dominant to blue, or rather presence of the brown pigment is dominant to its absence. So blue eyes are due to the absence of brown or to the presence of it in very small amount, in the posterior layer of the iris which shows through as blue.

Hair Color is due to stains of the medulla and cortex and to cortical pigment. The stains of the cortex range from yellow in flaxen hair to red or coppery while the addition of cortical pigment produces chestnut. Black hair is due to large granules of melanin, while the lighter shades of brown to blond are due to pigment granules which are smaller and less compact. The presence of granules is dominant to their absence. Hence dark haired parents may produce children with dark, or golden or red hair, while golden-haired parents beget only light-haired children.

Curliness of Hair. The degree of curliness in hair is due to its degree of flatness, straight hairs being cylindrical. The shape of the cross-section is probably due to several factors. Curley-haired and straight-haired parents produce an intermediate condition in the offspring, though curliness is generally regarded dominant. There are some cases of curliness which seem to be sex-linked, or possibly due to genes in the Y chromosome.

Pigmentation of the Skin. It would seem that pigmentation of the skin is due to a blending resulting from crosses between more than two allelomorphic factors. Mullatos which are an intermediate produced by crossing the white and black races are capable of producing children either lighter or darker than themselves and may occasionally produce

a child which is as lightly pigmented as a pure white, or as deeply black as the negro, but in the main they produce children much like themselves. A mullato mated to a white can only produce a child lighter in shade than himself, and mated to a negro only one darker than himself.

Albinism is a congenital inability to form pigment, hence the white hair and skin and the pink eyes. The color of the skin is due to the haemaglobin of the blood. The eyes are pink because the pigment of the iris is absent and the blood shows through.

Albinism is a simple recessive, hence it can be transmitted only by albinos or by heterozygous individuals. Heterozygous parents have a good chance of producing normal children, for one of four may be wholly free from the defect and fifty per cent only carriers.

Structural defects of the hands and feet are clearly hereditary. Polydactylism, which is an increase in the number of fingers or toes, usually the presence of one extra digit; Syndactyly, webbed fingers or toes; Brachydactyly, the absence of one phalanx in fingers or toes; all are dominants and carried on the autosomes, as is symphalangism which is a body union of two phalanges giving stiff fingers.

There was a John Talbot, First Earl of Shrewsbury, who had stiff fingers. He was killed in battle in 1453 near Bordeaux by having his skull crushed after his leg was broken. He was buried in Shrewsbury Cathedral. Recent alterations made it necessary to move the body which was easily identified by the crushed skull, broken leg and stiff fingers, the work of moving the body being in charge of a descendant of the 14th generation who also has stiff fingers.

A case is reported from Norway in which paternity was established by the fact that a child was born with webbed fingers, and the mother was normal and hence the child got the dominant determiner from his father. There was but one such individual in that part of the country and he was the accused, and he was declared the father.

Armlessness is known to behave as a dominant in some families. Harelip behaves as a pure recessive, though it is by some authors classed as a dominant. Dwarfness with short stout limbs is a dominant, while the condition in which the individual is normally proportioned is recessive. There are certain physiological characters which are inherited according to Mendelian Laws. An interesting one of these is that of blood group. We know the practical importance of this in the transfusion of blood. There are in the blood certain substances which are known as agglutins which under certain circumstances cause the clumping of the corpuscles of the donor of blood. There are four recognized groups, I, II, III, IV. Studies of their inheritance have led to two hypotheses, one holding that the type is due to the action of two pairs of factors, while another postulates three. In both cases two agglutinins are postulated and designated A and B. Bloods of group I will agglutinate those of all other groups. Those of II will agglutinate only those

of III and IV, and those of III will agglutinate those of II and IV, while bloods of group IV have no agglutinating powers. The fact that the blood type is inherited has been made use of in determining blood relationships, or better nonrelationship. Disputed parentage is sometimes cleared up by determining the type of the blood of the child and of the mother and the supposed father. If the child has an agglutinin which is not to be found in the mother's blood, then it received it from the father. If the supposed father lacks that agglutinin he is not the father of the child. If he has it, that fact is conclusive evidence that he is the father, for any man with the agglutinin could give the child the type of blood.

The condition of left-handedness is found in families and though it seems to be an inherited condition knowledge of its inheritance is too little to allow any definite statement in regard to it.

Twinning is known to occur in certain families. If twins are identical they must result from the splitting of a single ovum and are of the same sex, while fraternal twins result from two separate ovulations and fertilization of two separate ova. Multiple ovulation is of course on the part of the mother. Some cases of multiple instances, 9 in one case, of successive twin births of individuals of opposite sexes, cannot well be explained, for the inheritance if there is any would seem to be on the father's side, while we know that multiple ovulation on the part of the mother is necessary. A case of this kind is seen in fig. 111, p. 277, Lindsay.

Congenital Deaf-Mutism may be due to a number of causes, and it is to be distinguished from acquired condition. It seems quite clear that in many cases it is inherited as a pure recessive, but there are cases in which it seems to be inherited as a dominant. This is possible, for in the one case the condition may be due to the lack of development of the nervous elements in the organ of Corti, while in another it might be due to the cellular elements or pillars that have failed to develop. In either case complete deafness would result.

Fortunately most diseases which are inheritable are recessives and hence not so often transmitted. They follow the autosomes in most cases. This is true of such diseases as epilepsy, feeblemindedness, insanity of certain types, multiple sclerosis, Meniere's disease, chorea or St. Vitus Dance, deafness due to sclerosis of the middle ear, and others.

However some very serious conditions are dominant such as Huntington's chore which terminates in insanity and death. It never appears until about middle life and depending upon whether the individual is homozygous or heterozygous for the defect all or half of his offspring will inherit the disease. The same is true of muscular atrophy of the general type, not Gowers. Then too, heredity cataract, degeneration of the pigment of the retina, glaucoma, displaced lens, and sicle-cell anaemia all are dominants and travel on the autosomes. Diabetes and

cancer are questionably hereditary. Haemophilia, colorblindness, night blindness and optic neuritis are all recessives but they travel on the X chromosomes, and are hence what we know as sex-linked characters.

Human heredity is important for study because of the good that may be accomplished but there is here a very great danger that the study may lead to the enactment of eugenic laws taking from man his natural rights while aiming to accomplish something for the race which will require centuries of generations, and then meet with disappointing results.

FINAL GENERAL SESSION

On Saturday, August 13th, at 10:30 A. M., the final general session was held in the Chemistry Lecture Hall.

The reports of the secretaries of the different sections showed that the following officers had been elected for the coming year:—

Biology:	Chairman, Rev. Charles A. Berger Secretary, Mr. Arthur A. Coniff
Chemistry:	Chairman, Rev. Francis W. Power Secretary, Mr. Anthony I. Ecker
Mathematics:	Chairman, Rev. Joseph P. Merrick Secretary, Mr. J. Austin Devenny
Physics:	Chairman, Rev. William G. Logue Secretary, Mr. Lincoln J. Walsh

Then followed the report of the Committee on Resolutions. Father Joseph M. Kelley read the following resolutions:

The American Association of Jesuit Scientists, Eastern States Division, in the eleventh annual meeting at Holy Cross College adopts the following resolutions:

Be it resolved:

1) That the Association expresses to the very reverend Fathers Provincial deep appreciation of their continued support and encouragement given to the Association.

2) That the Association sincerely thanks Rev. Fr. Rector and his assistants for the hospitality extended to the Association in this meeting.

3) That the Association, as a mark of appreciation of the long and unfailing devotion of Fr. Brock to the development of the Association, convey to him a message of sympathy in the illness which keeps him from attending this meeting and a hope that future meetings will find him among us in renewed health.

4) That in accordance with a resolution adopted in the opening session of this meeting a memorial mass be said for Father George L. Coyle by each priest who is a member of the Association, and one Holy Communion and one pair of beads be offered up for the same intention by the non-priests, in token of esteem of our distinguished member; and also that a copy of this section of the resolutions be sent to Fr. Coyle's sister.

5) That the Secretary be instructed to present a copy of these resolutions to Rev. Fr. Rector and the others named herein.

The motion, that the resolutions be accepted, was made by Fr. Power, seconded by Mr. Carroll, and adopted by a unanimous vote.

The election of officers for the coming year followed. Father Joseph J. Sullivan was elected President of the Association, and Mr. Lincoln J. Walsh was elected Secretary.

The meeting was then given over to a general discussion.

It was proposed that the 1933 meeting be held at Chicago. In the discussion which followed, numerous advantages were urged, and in particular the possibility of holding our meeting in conjunction with the meeting of the Western States Division of Jesuit Scientists. Finally, Fr. Brown made the motion that the President of the Eastern Division get in touch with the President of the Western Division, in order to determine definitely whether or not the meeting be held in Chicago. This motion was seconded by Fr. Lynch and accepted by the unanimous vote of the members.

At the request of one of the members, Fr. Shaffrey then gave a brief explanation of the "Aptitude Test", telling of its purpose, of its advantages, and of the results obtained by it.

All the business of the general gathering having been concluded, the motion for adjourning was made, seconded and unanimously carried.

At the meeting of the Executive Committee, Father Richard B. Schmitt was reappointed Editor of the BULLETIN.

The following members were admitted to the Association:

NEW MEMBERS

Rev. Edward M. Crotty, S. J., St. Peters College
Rev. Thomas J. Smith, S. J., Weston College
Mr. Thomas A. Brophy, S. J., Gonzaga High School
Mr. Edward A. Callahan, S. J., Holy Cross College
Mr. William V. Cummings, S. J., Ateneo de Manila
Mr. J. Austin Devenny, S. J., Boston College
Mr. Thomas A. Duross, S. J., Woodstock College
Mr. Francis X. Flood, S. J., Loyola College
Mr. Armand J. Guicheteau, S. J., Ateneo de Manila

Mr. William L. Kelleher, S. J., Holy Cross College
Mr. Joseph P. Lynch, S. J., St. Joseph's College
Mr. Philip H. McGrath, S. J., Georgetown University
Mr. Francis G. Reed, S. J., Brooklyn Preparatory School

The following members of the Association were present:

Rev. C. A. Berger	Rev. T. J. Brown
Rev. T. P. Butler	Rev. E. C. Dubois
Rev. H. L. Freatman	Rev. J. A. Frisch
Rev. A. J. Hohman	Rev. J. M. Kelley
Rev. E. J. Kolkmeyer	Rev. A. B. Langguth
Rev. J. J. Lynch	Rev. W. G. Logue
Rev. T. H. Moore	Rev. J. P. Merrick
Rev. J. S. O'Conor	Rev. J. B. Muenzen
Rev. T. H. Quigley	Rev. F. W. Power
Rev. R. B. Schmitt	Rev. C. E. Shaffrey
Rev. T. J. Smith	Rev. J. P. Smith
Rev. J. J. Sullivan	Rev. G. F. Strohaver
Rev. J. G. Tynan	Rev. T. A. Tobin
Mr. A. A. Coniff	Mr. A. C. Carroll
Mr. A. I. Ecker	Mr. F. B. Dutram
Mr. J. L. Harley	Mr. P. J. Fitzgerald
Mr. J. G. Keegan	Mr. E. S. Hauber
Mr. D. Linehan	Mr. G. M. Landry
Mr. G. P. McGowan	Mr. J. P. McKone
Mr. J. J. Molloy	Mr. M. J. Miller
Mr. L. J. Walsh	Mr. J. J. Moynihan

BIOLOGY

RESEARCH PROBLEMS IN ANIMAL BEHAVIOR

(Abstract)

REV. JOHN A. FRISCH, S.J.

We do not possess degrees from recognized universities. There remains only our work as an index of our worth and ability. But, unless our work is published, even those within the Society will have only a general, hearsay appreciation of our rating: those outside of the Society will know us even less. To be worthwhile publishing our work should be of a research character.

The ease with which many of the Protozoa can be cultured and kept on hand the year around, the simplicity of the equipment needed for their study, the many unsolved problems they present in their life-histories, their structure and their physiology, the intimate bearing this study has on the question of vitalism, make these organisms preeminently suited for study by Ours.

A number of definite problems were presented.

HERITABLE AND NON-HERITABLE VARIATIONS

(Abstract)

JOSEPH G. KEEGAN, S.J.

Introductory

Variations which arise so often to confute the predictions based on the laws of descent must be studied and correlated before we can complete our knowledge of heredity in action. Can variations be advantageously perpetuated? Why do they sometimes fail to maintain themselves in the genetic apparatus? To this problem is closely allied the question of inheritance of acquired characteristics.

Discussion

1. Variations

    i. Definition

        An exception to the formula that 'like produces like'.

    ii. Classification of variations

        a. morphological, physiological and psychological
        b. single and multiple
        c. continuous and discontinuous
        d. heritable and non-inherited

    iii. Modification vs. Mutation

        De Vries and the 'Mutationstheorie'

    iv. Methods of studying variations

        The genetic approach
        The cytological inquiry

    v. Value of Mutations limited

        Great care to be used in assigning origin
        Many are ill suited for survival
        Laboratory conditions often foster weak strains which would succumb under ordinary rigor

2. Inheritance of Acquired Characteristics

    i. Need of an unbiased inquiry

        Adherents frequently have a case to urge
        Opponents think the theory intrinsically absurd

    ii. The problem defined and appraised

    iii. Weismann and the arguments against the theory

        Statement and evaluation of these arguments
        Validity of Weismann's arguments in the present state of genetics.

    iv. The case for the affirmative

        Kammerer's conclusions were 'too conclusive'.
            Result has been reflected in the suspicion that greets each new proponent.
        Some recent findings and their probable value.

    v. Present status of the question

        The theory has not been positively disproved, but
        The ascendancy seems to be with the opposition.

SEGREGATION AND INDEPENDENT ASSORTMENT

(Abstract)

Joseph P. Lynch, S.J.

It was Oscar Hertwig, who, in 1875, was the first to observe and understand the process of fertilization and thus to demonstrate clearly the nature of the contribution made by each of the parents in sexual reproduction. The doubt that till then had swung the pendulum of opinion between the accepted but erroneous theories of Preformation and Epigenesis had been got rid of at last.

Man has attained to visual proof of the laws of heredity by discovering the mechanism underlying and making possible facts whose existence was formulated with mathematical precision as early as 1865. Curiously enough it was not the microscope that led to the first discovery. Mendel used only pen and brain and his unaided observing eye.

The two laws first expressed by Mendel may be stated as follows: The LAW OF SEGREGATION; "The units contributed by each parent, separate in the germ cells of the offspring, without having had any influence on each other." And the Law of INDEPENDENT ASSORTMENT; "Distribution of the members of one pair of genes is independent of the distribution of the members of other pairs."

There is a definite number of chromosomes for each species of plant or animal. The male has the same number as the female, the number characteristic of the species. And each cell in a plant or animal contains chromosomes from male parent and from female. The number of the chromosomes is the sum of the equal numbers from the male and from the female—the sum constituting the number characteristic of the species. This sum, as found in each of the cells of the body, is the result of the longitudinal splitting of each chromosome in the fertilized egg, and a repetition of this in each successive cell-division. In practice we find in various species what are called X and Y chromosomes. In such a case distinction is made between the regular paired chromosomes, called pairs of autosomes, and the X and Y chromosomes.

The cells that specialize for the reproduction of the particular plant or animal, must undergo a modifying process, in order that by the addition of the male chromosomes to the female chromosomes, when an egg is fertilized, the resulting sum will be the number characteristic of the species. This is accomplished by reducing to a half the number of chromosomes in the cells specializing for reproduction of the species. Hence there is a reduction process in the male, called Spermatogenesis; likewise in the female, referred to as Oogenesis.

(Then follows a detailed consideration of the two processes of Maturation.)

We see the way the Law of Segregation is substantiated by the separation of the sexual elements in the First Maturation Division, since the

Second Spermatocytes and the Second Oocyte have each but the Factor from only the male or the female parent, for each pair of allelomorphs. But as regards the Independent Assortment there is difficulty. Certainly the processes of spermatogenesis and oogenesis provide a physical and mechanical mode making the independent assortment readily feasible. In Mendel's original experiments where two or more pairs of factors were involved, undoubtedly there was independent assortment of the factors responsible for each hereditary trait. That the factors are in the chromosomes is generally admitted. However, since the number of inheritable characters may be large in comparison with the numbers of chromosomes, or the number of pairs of contrasting characters with the number of pairs of chromosomes, we expect to find not only the independent behavior of pairs of allelomorphs, but also cases in which characters are linked together in their inheritance. As a matter of fact there have been found many cases of precisely this.

In summary, then, we see that Segregation, the separation of male and female elements for each pair of allelomorphs is a well-substantiated fact, occurring, in all likelihood, in the first maturation division in spermatogenesis and oogenesis; and also that Independent Assortment of the genes for the various inheritable characteristics is likewise a general fact, whose basis is in not only the first maturation division, but also in the second maturation division where the reduction of the number of the chromosomes takes place. Independent Assortment is a general fact,—but with exceptions that are enumerated and discussed in another member's paper.

HEREDITY AND ENVIRONMENT

(Abstract)

James L. Harley, S.J.

From the other papers of the Symposium we have the facts which furnish us with a rounded concept of heredity, but for this paper it is sufficient to say that heredity is "the continuity from generation to generation of certain elements of germinal organization." In other words, only those characteristics are hereditary which are produced by some material factor born on the spermatozoon of the father and of the ovum of the mother. We may say that hereditary characteristics are determined definitely in each individual at the moment of conception or fertilization, for in bi-parental reproduction, once the egg and sperm have united, the inherited properties are fixed for life. Any circumstances or

condition which may influence the development of the organism after this (even between the time of conception and birth) is called environment. Those conditions or circumstances which affect the organism from without, such as atmosphere, temperatrue, etc., are called external, while those which arise within the organism itself, such as neighboring cells, hormones, etc., are called internal.

By experiment it has been discovered that many characteristics which are due to heredity may also be caused by environment, and vice versa. This is not always the case but it warns us to use extreme caution before labeling a particular characteristic as hereditary or environmental. The test to see whether a given characteristic follows the laws of heredity is developed more at length in the paper on Pure Lines.

When it comes to the study of heredity and environment in man, many factors make the inquiry rather difficult. The most noteworthy advance that has been made in this regard has come from the study of Identical Twins. But even here the results have not always been the same.

To the old question: "Which is more important, Nature or Nurture?" the saner biologist will reply: "Yes." That is, we can't get along without either, so both are important. However, if pressed for a more definite reply in regard to man, the more conservative biologist will distinguish and say; "In determining physical characteristics, heredity seems to be more important, while in the determination of mental and emotional characteristics, environment seems to be more of a deciding factor."

THE CHROMOSOME THEORY OF HEREDITY

(Abstract)

Rev. John A. Frisch, S.J.

Mendel's laws of segregation and independent assortment indicated definite, persistent, specific unit structures, responsible for the development of hereditary characters.

The discovery of the chromosomes and their behavior in the maturation of the germ cells led Sutton in 1902 to call attention to the fact that the behavior of the chromosomes parallels the behavior of the Mendelian units. Both undergo segregation and independent assortment.

Bateson and Punnett's discovery of linkage in 1906 was to be expected, if the units or factors were in the chromosomes, since the number of inheritable characters may be large in comparison with the number of pairs of chromosomes.

Since 1910 four groups of linked characters have been discovered in Drosophila melanogaster corresponding to the four pairs of chromosomes. This same numerical correspondence of chromosomes and linked groups of factors has been found in other organisms and all experimental work is only extending the evidence to other forms.

The various types of Mendelian inheritance, linkage, crossing-over can thus all be adequately explained by the chromosome theory of heredity.

It had been argued that the chromosomes are artifacts, merely condensations of the cytoplasm and therefore chemically identical with the cytoplasm, that they are not persistent structures passed on from generation to generation, but are reformed from the cytoplasm in each generation. Boveri's proof of the non-fragmentation of the chromosomes during the resting stage, his demonstrations of the importance of the nucleus over the cytoplasm and his dispermic studies showing the specific effect of chromosomes in development refuted these objections.

Moenkhaus by a cross of a Fundulus female having long chromosomes with a male Menidia having small spherical chromosomes showed that the two types of chromosoems were found in the fertilized egg and persisted in every succeeding generation. Doncaster furnished the same proof with a cross of two species of Abraxas moths as did Federley with Pygaera moths. Baltzer and Herbst did the same with a cross of the sea-urchins Sphaerechinus and Strongylocentrotus.

Thus, even an abnormal set of chromosomes once established in a cell tends to persist through all succeeding generations, indicating that the chromosomes are not mere products of the rest of the cell, but are self-perpetuating structures responsible for specific effects.

THE STABILITY OF THE GENE AND SELECTION

(Abstract)

Arthur A. Coniff, S.J.

Genes exist as paired elements in the germinal material and are the determiners for hereditary characters. The members of each pair of genes separate when the germ-cells mature in accordance with cytological evidence of chromosome reduction. Each gamete, therefore, comes to contain one set of genes. If two gametes of identical gene content meet in fertilization the resulting zygote is said to be homozygous. The descendents from a single homozygous zygote, exclusively propagating by

self-fertilization, has been defined by Johannsen as a "Pure Line". Selection within such a pure line is entirely without effect, as demonstrated by the pure lines of beans obtained by him. In the case of animals, where self-fertilization does not occur, one must be more cautious. When, however, two such organisms, identical in their germinal determiners with regard to a particular character, are inbred their progeny will form a pureline so far as this particular character is concerned.

Neither of the former cases, however, excludes the possibility of "Modifying Genes" being present, which influence the degree of expression of a particular character, so that selection may yet be effective. In the one direction those genes may be isolated that increase, and in the other, those that decrease the expression of any particular character. An example of such a character is the hooded pattern of rats, which may be permanently increased or diminished by selective isolation of modifying genes. A similar case is the two strains of white sweet peas obtained by Bateson. Here modifying genes existed entirely undetected in pure lines, but, when they meet in a cross, they exerted a complimentary influence on one another and an entirely new character was produced, namely the purple color of the hybrid. The proof for the existence of these complimentary genes was founded on the assumption of the independent and stable nature of the gene, and the results of the experiment tallied exactly with Mendelian expectations for the behavior of a di-hybrid.

Thus far the gene has demonstrated a remarkable constancy, but to test the matter further, characters were studied, which are due to genes, but whose somatic expression is at the same time extremely sensitive to environment. Here, if anywhere, an acquired character might possibly be transmitted to the germinal material, thus destroying its stability. But again, no matter how long the selection continued in the direction of an environmental change, the gene remained constant in its effect. This experiment was carried out for abnormal abdomen and eyeless of Drosophila, in the latter case for sixty generations without any apparent change.

If the gene were not stable, acquired characters might yet be proved capable of being inherited in the strictly genetic sense of permanent change in the germ material and selection prove of some avail to alter a race for better or worse. Therefore it is not with surprise that we find that the most persistent attacks against the Theory of the Gene have been directed against the stability of its fundamental unit, the gene. Up to the present time these attacks have completely failed and that which was brought forth as most damaging evidence, only resulted, upon further investigation, to confirm the belief in an unalterable germinal material responsible for every inherited character.

GENETICS AND EVOLUTION

(Abstract)

Rev. Charles A. Berger, S.J.

In the light of the findings of modern Genetics it appears that the only theory of evolution still possible is one in which new species are formed by the incorporation of many new mutations which are at the same time beneficial (or at least not harmful) and dominant. The knowlege we have at present of the nature of mutations seems to render even this course highly problematical. This paper contained an account of several recent experimental findings pertinent to the species question.

Over 200 species have been described in the genus **Drosophila.** Metz has determined the chromosome complex of some eighty species of this and closely related genera. The chromosome groups in all these species can be arranged under some one of thirteen type groups. These type groups are so familiar that the thought immediately arises that they may have arisen from one another by a process of chromosome translocation, fragmentation, attachment or reduplication; all of which processes have been detected in the genetic work on **Drosophila.** In an effort to find the nature of the difference between similar species with similar chromosome groups some two hundred species crosses have been tried. Only one of these **D. melanogaster** x **D. simulans** produced offspring and even here the hybrids are completely sterile. A thorough study of the genetics of **D. simulans** was made and some 57 mutations have already been found in this species. The somatic effects and the gene locations of these **simulans** mutations have been compared with corresponding mutations in **melancgaster.** The chromosome maps of the two species show a remarkable similarity. Twenty-six of the **simulans** mutations are the same in their somatic effect as similar **melanogaster** mutations, and are situated in the same chromosome in the two species. The genes for fourteen mutant characters common to both species are not only in the same order and show approximately the same linkage relations. To test the question whether these genes were identical in the two species or merely similar in their effects species crosses were made using races that had the same mutation. For Example: white-eyed **D. melanogaster** were crossed with white-eyed **D simulans.** In both species the white-eye character is recessive and requires the presence of two genes to bring about its somatic expression. These hybrids would have one melanogaster gene for white-eye and one simulans gene for white-eye. If these two genes were identical the hybrid should have white eyes, if they were different genes which merely happened to have the same somatic effect the eyes of the hybrid should be the normal red color. Twenty-six of the similar mutant genes were found by this test to be identical in the two species since they acted as a pair of allelomorps in the hybrid. Eight other genes with similar somatic effects in the two species were found to

be due to different genes in the two species, as the hybrids in these cases were normal for the character in question and gave no external sign of the recessive mutant characters in their parents.

The intensive study of closely related species has brought out another interesting fact namely that in many cases the mutant characters within a species are very similar to the specific characters which distinguish one species from another. There are however differences between the diversity of species and of mutant races. Species usually differ in a large number of small characters while mutant races are alike in most characters and differ strongly in one or a few characters. No conclusions can as yet be drawn from these findings but they are important as they constitute the first scientific experimental attempt to understand the difference between species which is the foundation of the evolution question.

CHEMISTRY

MICRO DUMAS METHOD FOR NITROGEN

(Abstract)

Rev. R. B. Schmitt, S.J.

This paper described in detail the improved Pregl method for the micro Dumas determination of nitrogen in organic substances. In a practical way some of the difficulties encountered by the various authors can be successfully overcome by the use of a suitable gasometer placed between the Kipp generator and the combustion tube. The combustion of the substances to be analysed is always carried out with a standard amount of carbon dioxide, the purity of which can easily be determined. In this manner uncertainties in regard to the end of the analysis are at once eliminated.

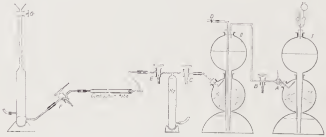

Figure I.

A Kipp generator which is connected to another Kipp generator provides the necessary carbon dioxide. The gasometer is connected with the Kipp generator by means of a stop-cock. The combustion tube, which is filled according to the Pregl method, is connected with the generator by means of a two-way stop-cock. Finally connection is made with the micro azotometer by means of a double capillary stop-cock.

The method of procedure includes: 1st, the sweeping-out of the combustion tube with carbon dioxide; 2nd, the actual combustion; and 3rd, the washing-out of the combustion gases.

While the combustion is in progress the gasometer is being filled with carbon dioxide from the Kipp generator. The bulb containing the mercury is lowered until the mercury in the gasometer reaches the mark. At the end of the combustion the stop-cock is opened carefully so as to give the desired flow of the gas.

Since even the purest carbon dioxide obtained in these experimental conditions still contains some air, the amount can easily be determined by a blank test carried out in an exactly similar manner.

Recently, the sources of error have been carefully studied and are now incorporated in all determinations with excellent results. Those discussed included: the possible dissociation of gases in the combustion tube; carbon dioxide generator; adsorption error; calibration of azotometer; adhesion of potassium hydroxide to wall of azotometer; vapor pressure of potassium hydroxide; temperature and barometric reductions.

A sample calulation with total corrections was given.

DISSOCIATION CURVE FOR AMMONIUM CARBAMATE

(Abstract)

Rev. Joseph J. Sullivan, S.J.

Since this substance has a high dissociation pressure at fairly low temperatures, it occurred to us that it might be a handy substance to use in the laboratory in demonstrating to students of Physical Chemistry some of the principles discussed in the chapter on Heterogeneous equilibrium.

We, therefore, prepared this substance and determined its dissociation pressure at temperatures from 15° to 55°C. From a change of the equilibrium constant, with temperature, we determined the heat of the reaction from the accepted Clausius-Clapeyron equation. The results seemed quite gratifying and so we suggested this as a possible experiment in the laboratory in Physical Chemistry.

The Ammonium Carbamate was prepared by allowing a stream of carbon dioxide and of ammonia gas (which we purchased in small tanks from the Matheson Chemical Company) to meet in dry Benzene. The Ammonium Carbamate was then filtered through a Buchner Funnel, pressed out on a porous plate, and then dried in a dessicator over Calcium Chloride for several hours. It was then introduced into a glass tube and sealed onto a manometer, the final seal being made when it is quite apparent that the dissociating ammonium carbamate has driven out the air from the reaction tube.

Our results gave dissociation pressures which were slightly lower than those found in the laboratory. This fact may be explained by two reasons at least; first, a slight amount of moisture in the system, and secondly, failure to totally remove all the air from the apparatus.

The equilibrium constant, as we know, may be obtained from the following expression:

$$P^2_{NH_3} \times P_{CO_2} = K_P$$

From the Clausius-Clapeyron equation:

$$2.3 \log \frac{K_2}{K_1} = \frac{\Delta H}{R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$$

the heat of the reaction may be determined.

THE EFFECTS OF CERTAIN SALTS ON THE SURFACE TENSION OF SOAP SOLUTIONS

(Abstract)

Edward S. Hauber, S.J.

The salts considered were some of those used in the manufacture of soap for the laundry trade, namely, sodium carbonate, trisodium phosphate, "BW" silicate of soda, "Star" silicate and a "Modified soda" which consists of a mixture of equal parts of sodium carbonate and sodium bicarbonate. There was a brief discussion on the function of the soap as an emulsifying agent for the removal of the greasy material surrounding the dirt. It was seen that the effectiveness of the cleansing power of the soap depended on the surface tension of the soap solution, which in turn was a function of the salt used in the making of the soap.

The concentration of the soap solutions used were 0.03 per cent, while the concentration of the salts was varied. The apparatus for measuring the surface tension of the soap solutions consisted of a measuring pipe sealed into a capillary tube with a carefully ground tip and the flow was controlled so that drops formed were slow and uniform. The ideal drop volumes were used in calculating the surface tensions and it was found that the most effective salt in reducing the surface tension was sodium carbonate.

MOLECULAR REARRANGEMENT OF N-CHLORACETANILIDE

(Abstract)

Gerard M. Landrey, S.J.

The rearrangement of N chloracetanilide to the isomeric p-chloracetanilide was first studied in absolute ethyl alcohol solution without the aid of a catalyst. In this solvent a period of inhibition of variable duration preceded the period of rearrangement. The rearrangement started suddenly and proceeded at a very high velocity. A progressive rise in value of velocity constants indicated an autocatalytic nature of the rearrangement. A thermometer, graduated in tenths of a degree, indicated by rise of its mercury column the start of the reaction. The course of the reaction was followed by adding samples of reaction to potassium iodide-starch solution and then titrating with sodium thiosulphate. In this way the amount of untransformed N-chlor was determined. When unacidified potassium iodide was used with fresh solutions of N-chlor approximately one half of the N-chlor present displaced iodide ion from the ionic state while all of the N-chlor displaced iodide ion when the potassium iodide had been acidified.

Freshly prepared alcoholic solutions of the N-chlor compound diluted with water were neutral to litmus, while completed reaction mixtures diluted with water were acid to litmus. Perhaps hydrochloric acid was split out in a union of the solvent and a portion of the N-chlor to form ethoxyacetaminobenzene. This product was not isolated and identified. Specially prepared p-chlor compound had no effect on the rearrangement, but samples of completed reaction mixture had a decided accelerating effect on the rearrangement.

The rearrangement was studied in a solvent that would not admit a splitting out of hydrochloric acid. In specially purified, dehydrated acetone varions conflicting phenomena were observed. In acetone alone the N-chlor compound was stable for several weeks. Samples of completed reaction mixture diluted with water were neutral to litmus. When a small amount of dilute hydrochloric acid was added to acetonic reaction mixture the rearrangement barely got started in seventeen hours. When the same concentration of hydrogen chloride but greater concentration of water was used, the rearrangement proceeded normally without a period of inhibition. When dry hydrogen chloride (gas) was passed through an acetonic solution of the N-chlor compound the rearrangement took place instantaneously.

No definite conclusions as to the mechanism of the rearrangement were achieved.

THE HALOGENS AS EMULSIFYING AGENTS

(Abstract)

Rev. Joseph J. Sullivan, S.J.

Benzene and water do not form a stable emulsion unless some agent is employed to cut down the surface tension at the interface. Various emulsifying agents have been tried. At Boston College last year, we tried the effect of the halogens, i. e., chlorine, bromine, and iodine, on this phenomenon and obtained some rather unique results.

The only work on halogens reported in the literature was work carried on under the direction of Doctor Holmes of Oberlin College and he was working with an ether-water emulsion, using iodine as an emulsifying agent.

Our work with chlorine indicated that there was a disperse phase formed of great stability. However, no aggregates could be perceived in the ultra-microscope. It seemed, therefore, that chlorine brings about a condition which is similar to that of a "fog" rather than an emulsion. Stabilities with the other halogens, i. e., bromine and iodine, gave variations which increased with decreasing halogen concentraton but which did not seem to follow the accepted rule, which appears to have been formulated with regard to varying viscosity and surface tension.

It would seem that viscosity is the determining factor in the stability of the bromine emulsions, whereas surface tension seems to be the controlling factor in the stability of the iodine emulsions.

Sodium oleate was used as a control in ultra-microscopic work. In all cases of the benzene-water systems the following physical properties were determined: Surface Tension, Viscosity, Refractive Index, and Stability.

MATHEMATICS

EXPONENTS-LOGARITHMS

(Abstract)

DANIEL LINEHAN, S.J.

The thoughts which were brought forth in this paper did not dwell as much on the theory of logarithms and methods for explaining the theory, as it did upon the time of the year when logarithms might be taught to the students of the A. B. Freshmen sections.

Since logarithms are usually taught in connection with the trigonometry classes, then we can begin the year with the ideas pertaining to functions, etc., and solve problems which are composed of integral numbers, and which will accordingly be of easy solution. This allows most of the concentration to be directed towards the formation of trigonomet ric equations, and the simple arithmetic or algebra therein contained can be taken for granted.

Eventually the equations may remain the same but the simple numbers substituted by more complex values until the students can readily see that their trouble now rests not in trigonomerty, but in the arithmetic and algebra. The idea of "short cuts" and "easy methods" can be proposed for this complicated work, and the teachers propositions can be supported by the introduction of logarithms to the students' knowledge. Demonstration in class will prove that logarithms will save them much time, and with certain methods will promote a greater accuracy than they had enjoyed before.

Since the 'practical usage of things' seems to hold the greater persuasive power over the students than many another motive, the teacher can introduce problems from the physics lab. and show how the use of logarithms will facilitate their solution, and at the same time remind them that, in a year or so they too will be attempting to solve these same problems in their physics course.

CRITICISM OF A RECENT METHOD FOR "TRISECTING" AN ANGLE

REV. FREDERICK W. SOHON, S.J.

This article will appear in its entirety in the following issue of the Science Bulletin.

COORDINATES

(Abstract)

Rev. Joseph P. Merrick, S.J.

The various types of coordinates, Cartesian, plane polar, spherical polar and cylindrical were described and the transformation from one system to another was demonstrated. The elegance of spherical polars was shown by using them to find the volume of a sphere.

Orthogonal coordinates and the Jacobian and generalized systems were then explained. Finally the use of tetrahedral, paraboloidal in wave mechanics of the atom, and the pentaspherical were alluded to. Tait's principle that the intersection of three surfaces is the best determinant of a point was offered for evaluation.

VECTORS

(Abstract)

J. Austin Devenny, S.J.

I. When can concept be introduced?—Two answers:

1. Possible to introduce in place usually assigned to trigonometry.
2. Better to introduce only after calculus and physics.

II. How to introduce it:

1. Vector Algebra:—
   a) definition of vector, vector addition and subtraction, scalar and vector products, and their applications.
2. Vector Calculus:—
   a) definition of derivative of vector function of single scalar variable and of the corresponding integral;
   b) definition of derivative of scalar and vector point function;
   c) the mathematics of del;
   d) definition of line integral, of surface integral, of volume integral;
   e) Gauss's and Stokes's Theorems;
   d) applications.
3. Linear Vector Function:—
   a) beyond scope of undergraduate course.

III. Suggestions:

1. Distinguish between:
   a) abstract mathematical theory;
   b) geometrical interpretation;
   c) physical interpretation.
2. Treat the physical phenomena (under 'c' above) separately.
3. Where convenient introduce purely scalar treatment for the sake of comparison.
4. Select notation carefully.

MATHEMATICAL INDUCTION

(Abstract)

Rev. Thomas H. Quigley, S.J.

Mathematical Induction, called by Poincare 'mathematical reasoning par excellence', was according to Dr. Vacca first discovered by F. Maurolycus and published in his work entitled: 'D. Francisci Maurolyci, Abbatis Messanensis, Mathematical Celeberrimi, Arithmeticorum Libri Duo.'

In the preface to his treatise Maurolycus writes: "Nos igitur conabimur ea quae super hisce numerariis formis nobis occurrunt exponere; multa interim *faciliori via demonstrantes*, et ab aliis authoribus aut neglecta, aut non animadversa supplentes." An examination of this easy method of demonstration will show it to be the method of mathematical induction.

Professor W. H. Bussey, writing of mathematical induction in the American Mathematical Monthly (May, 1917), says: "It is not a method of discovery but a method of proving rigorously that which has already been discovered. It is one of the most fruitful methods in all mathematics. It has applications in widely different branches of mathematics, in algebra, trigonometry, calculus, theory of probability, theory of groups, etc."

Although to use mathematical induction in this or that branch of mathematics will obviously demand some knowledge of the branch in question, yet an understanding of the method itself presupposes no more than the mere elements of logic. There seems, then, no reason why the teaching of this powerful method of reasoning should not have a place even in the high school course of mathematics.

An excellent introduction to mathematical induction can be found in "College Algebra" by Dr. W. L. Hart of the University of Minnesota (Heath & Co.). The following references will be useful:

History of Mathematics—Smith Vol. I p. 301. (Ginn, 1923).

"Maurolycus, the First Discoverer of the Principle of Mathematical Induction"—Dr. G. Vacca (Bulletin of American Mathematical Society, November, 1909).

"Origin of Mathematical Induction"—Professor W. H. Bussey (American Mathematical Monthly, May, 1917).

THE GNOMONIC PROJECTION

(Abstract)

Paul J. Fitzgerald, S.J.

The gnomonic projection of a sphere is the projection from a point source at the center of the sphere upon a plane tangent to the sphere. A gnomonic projection map possesses this peculiar property, that a great circle on the sphere is represented by a straight line on the gnomonic projection map. This fact is evident from the construction. Every plane passing through the center cuts the surface in a great circle. But every projection from a point source at the center lies in a plane passing through the center. Every such plane intersects the plane of projection in a straight line; so, the gnomonic projection of a great circle is a straight line.

The shortest distance between two points on the surface of the sphere is the arc of the great circle through these two points. So to find the shortest sailing course between two ports, it is only necessary to draw on the gnomonic map, a straight line between these two ports. In this way also, obstacles in the direct course are readily detected, and the shortest complex course can readily be drawn.

Radio waves around the surface of the earth follow the path of great circles. This fact helps to determine the identity of the sending station, by plotting on the gnomonic map a straight line in the direction that the signals are received. Gnomonic maps are extensively employed by polar fliers; many of the newspaper maps of round-the-world courses are gnomonic.

Two types of gnomonic map are most common, those with the pole at the center, and those with the equator as the X-axis. The construction of both is simple; and the formulae for plotting individual points are as follows:

I For polar maps, X equals r cot Θ sin λ

Y equals -r cot Θ cos λ

where "r" is the radius of the sphere of reference, Θ the latitude and λ the longitude.

II. At the equator,

X equals r tan λ

Y equals r tan Θ sec λ

PHYSICS

SEISMOLOGICAL PROSPECTING

(Abstract)

Rev. John G. Tynan, S.J.

The first proposal to use artificial earthquakes in the study of the velocity of elastic earth waves was made before 1888 by Mallet and Abbot in England. Since that time artificially produced earthquakes have been very revelatory in the case of some earth formations; and in the discovery of salt domes in the oil regions of Texas and Louisiana, they have scored rather brilliantly.

Several minor advances were made up to 1912 when Galitzin proposed the use of explosions to study the velocity of the transverse and longitudinal waves in the uppermost formations, and pointed out that the velocity depended in a high degree on the physical character of the beds; and that from changes in velocity conclusions could be drawn as to the composition of the beds.

The elastic earth waves in different geological formations, varying in speed of tranmission are the foundation of all seismic geophysical prospecting. In the case where formations with a high speed of transmission underlie formations with a lower speed, the travel time of the earthwaves, which are reflected from the underlying bed back to the surface or refracted along the upper surface of that bed and then refracted back to the surface, reveals the presence of, and certain facts about the underlying bed. The speed of transmission may be said to be proportional to the denseness and compactness of the formation.

Some observers record and make their computations from the simple reflected wave but this does not supply either the accuracy or the detail which the refracted wave supplies. The refraction method takes advantage of the fact that the path of the wave down to the underlying bed, along it and back to the surface is traversed in shorter time than the direct wave along the surface. Waves normally travel over both paths and if the siesmograph records only the wave along the surface the inference is warranted that no refracting i. e., no high speed bed is underlying, at least within a distance proportional to the strength of the shot used.

Very little has been published about the interpretation of the seismograms, but the theory underlying the interpretation may be handled by applying 1) the optical laws of refraction and reflection, 2) Fermat's principle stating that any light ray travels in such a manner that the time

required to pass from one point to another will be a minimum. In the interpretation the very first wave, the refracted wave, is most noticeable. Then there will follow the direct wave thru the upper formation—from explosion point to instrument. Other waves may also follow, but they are seldom considered. The travel time of the first wave is computed from the various grams of the same shot, and a travel time curve is made. A resulting straight curve is proof that there are no geological unconformities present to warrant further prospecting. If a straight line curve is not produced, it is clear that the wave has met a new obstacle and has had to be reflected off or refracted thru it. In such a case further prospecting is made to determine the nature of the obstacle. For this purpose a study is made of the transmission velocities thru different kinds of formations, and the grams are re-examined to determine whether and by how much the wave was accelerated or retarded—arriving at an approximation of the character of the obstacle.

PHYSICS IN THE ARTS AND SCIENCE COURSES

Rev. John A. Tobin, S.J.

The subject matter of Physics has increased so greatly during the last quarter century, that it has become increasingly difficult for the college teacher to give an adequate survey of the field in the short space of one year. To determine what subjects should be given and what subject omitted we must decide on the purpose of the Physics in the Arts course, for only one year is given to Physics in this course. The first reason for a Physics course in the Arts courses is to help towards a liberal education. The student is introduced into the world in which he lives, to nature, and to the industrial world. He is trained to grasp and hold precise ideas, to observe how the quantities vary, to measure these quantities accurately and find the constant that connects them, and to reason logically from the principles that he has observed. Another purpose is to prepare the student for his course in Cosmology.

With these purposes in view the teacher then must select subjects that help the student obtain this end. As it is a general course we take all the parts of Physics, as the chemists take all the branches of chemistry in the pandemic course in Sophomore. In the five branches of Physics, Mechanics, Heat, Sound, Electricity and Light, we then must select what best serves the purpose. As a preparation for the Cosmology some time should be given to an elementary explanation of modern physics. And this very fine training in personal observation, hard work, willingness to look up what is presupposed, logical reasoning in problems, and training in self reliance in the laboratory, should not be dropped or made an elective merely because the work is difficult. A student in the A.B. course without a course

in physics has not received a liberal education, any more than a student in physics without any cultural subjects.

In the B. S. course however, the four years of Physics give us more time to train the student to be a friend of the physical world and not merely be introduced to it as in the Arts courses. The subject matter is the same five branches as in the general course. In Freshman he takes the first three Mechanics, Heat and Sound, and in Sophomore, Light and Electricity. As the classes are smaller and the mathematical training of these two years keeps his tools very sharp, the branches can be given more thoroughly than in the A.B. course. Add to this the mental attitude of the student, as he has selected this course, and wants the subjects for his future work. Then in Junior and Senior the Chemistry and Biology men drop physics, but the physics men take each branch again with calculus and vector analysis as helps. The schedule of courses as given may be found in the Boston College Bulletin. Pages 103—106 and 94—96. (1932)

This schedule as determined by the board for both provinces a few years ago gives a broad fundamental training with enough English, Modern Language, History and Philosophy to make it a liberal education if not a classical one. For the B.S. man should not only be able to solve the scientific problems and interpret the phenomena, but must be able to convert his highly specialized technical knowledge into very fine English that can be easily understood by non-technical minds. To safeguard the B.S. man from being a narrow-minded experimenter he must appreciate the cultural subjects as literature and philosophy. This course then gives the minimum basic training required for advanced work for a Masters and then a Doctors degree. He may plan to be a research Physicist, or a Physics teacher, or an engineer, or train for some industry, but our course gives him the necessary foundation for that future work. He does not specialize in the strict sense until he has a degree. He merely elects Physics and Mathematics or Chemistry or Biology in his Junior and Senior years so as to prepare for his special work that will follow. Built on this strong foundation of balanced cultural and scientific studies the B.S. man is capable of specializing in the sciences when he leaves college.

From the first teaching in Coimbra in 1547 the Society has not only demanded Physics as an integral part for all students who want a liberal education but it has always given the "Speciales" an opportunity for advanced work in the sciences. If you read the history of our educational work it is surprising to see the great emphasis given to the sciences. Before the war, an A.B. student had a strict course in Analytic Geometry and Trig. in Freshman, Mechanics in Sophomore, Physics in Junior, and Geology and Astronomy in Senior, with Calculus in Junior. These were not elective. Since the war all but the Physics in Junior have been dropped. After many struggles, as the number of students were small and the expenses high we have at last made a strict B.S. course that brings back the ideals of the Society. In doing this we have advanced with the education outside in the colleges. They make their comparisons, unfairly perhaps, but actually by comparing their science course with ours. They do not visit the Latin and

Greek classes as so many have dropped them. The competition in the industrial world is very keen and they want well educated young men who know their branches. Since 1895 the whole field of Physics has been changed. Radio activity, X-rays, Spectrum analysis, and the mathematical theories demand from the student a power of giving COORDINATED accounts of FUNDAMENTAL results and the interrelationship between the facts by means of theories. He must give quantitative results and constants of his observations and then explain the facts by a theory. This fundamental knowledge is then applied by the engineers to every day life and industry, and so there are few large industrial plants without their research laboratories. The aim of the B.S. course is to train the student then to reason strictly and to give him the ability to continue in research work. Not only exact knowledge but an active curiosity to get at the foundations, and analyze the great physical problems of today is the great need in Physics. In the B.S. course we strive to give the student, not only the exact knowledge required, but this active curiosity.

THE JUNIOR ARTS AND BACHELOR OF PHILOSOPHY STUDENTS

(Abstract)

George P. McGowan, S.J.

Some personal experiences in the class-room and laboratory were presented. The lack of knowledge of fundamental Mathematics on the part of the Junior student, about to take up the general treatises on Physics, was exposed, and a preliminary course of two weeks, covering the necessary prerequisites for studying Physics was outlined. The course included drilling in fractions, simple geometry, logarithms, and trigonometrical functions and a clear concept of an equation and algebraic symbols. The necessity of clean-cut, simple, discriminating definitions on the part of the teacher, as well as simple and adequate treatment of Physical notions was indicated. Teaching, with its various forms of drilling and repetitions was urged, as opposed to Lecturing. Intelligent direction in the laboratory as opposed to the method of making the sudent entirely responsible for even the initial work in the laboratory, for principles untouched in class, for use of apparatus wholly unfamiliar to him, was upheld as the only effective procedure, and taking the student as he actually enters upon the General Physics course, as the system productive of intelligent and fruitful results. A plea was made to give a good general course, with trigonometry as the basis for Kinematics, a course that would not be excessively technical, thus insuring that students whose averages in other subjects are creditable, might do equally well in Physics. Finally it was urged that we bend every endeavor to insure the maintenance of the General Physics course in our colleges as an essential to the degree in Arts and Philosophy.

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Callahan, Edward A., 1932, Holy Cross College, Worcester, Mass.
Coniff, Arthur A., 1928, Woodstock College, Woodstock, Md.

Didusch, Rev. Joseph S., 1922, Novitiate of St. Isaac Jogues, Wernersville, Pennsylvania.

Dore, Rev. Francis J., 1922, Boston College, Boston, Mass.

Dowd, Rev. Austin V., 1926, Woodstock College, Woodstock, Md.

Dubois, Rev. Evan C., 1924, Boston College, Boston, Mass.

Flood, Francis X., 1932, Loyola College, Baltimore, Md.

Freatman, Rev. Harold L., 1924, St. Peter's College, Jersey City, N. J.

Frisch, Rev. John A., 1924, Loyola College, Baltimore, Md.

Gookin, Rev. Vincent A., 1923, St. Beuno's College, St. Asaph, North Wales.

Harley, James L., 1927, Woodstock College, Woodstock, Md.

Keegan, Joseph G., 1930, Canisius College, Buffalo, New York.

Kirchgessner, Rev. George J., 1925, St. Andrew-on-Hudson, Poughkeepsie, New York.

Lynch, Joseph P., 1932, St. Joseph's College, Philadelphia, Pa.

MacCormack, Rev. Anthony J., 1925, Gonzaga University, Spokane, Washington.

McCauley, Rev. David V., 1923, Woodstock College, Woodstock, Md.

Pfeiffer, Harold A., 1931, Gonzaga High School, Washington, D. C.

Reardon, Rev. Francis X., 1925, Ateneo de Manila, Manila, P. I.

Shaffrey, Rev. Clarence E., 1923, St. Joseph's College, Philadelphia, Pa.

Smith, Lloyd F., 1930, Holy Cross College, Worcester, Mass.

Walter, William G., 1930, Canisius High School, Buffalo, N. Y.

CHEMISTRY SECTION

Officers

Chairman, Rev. Francis W. Power, Fordham University, New York City.

Secretary and Sub-Editor of Bulletin, Anthony I. Ecker, St. Peter's High School, Jersey City, N. J.

Members

Ahern, Rev. Michael J., 1922, Weston College, Weston, Mass.

Bihler, Rev. Hugh J., 1925, Fordham University, New York City.

Blatchford, Rev. John A., 1923, Winchester Park, Kingston, Jamaica, B. W. I.

Brophy, Thomas A., 1932, Gonzaga High School, Washington, D. C.

Brosnan, Rev. John A., 1923, Woodstock College, Woodstock, Md.

Brown, Rev. Thomas J., 1922, St. Joseph's College, Philadelphia, Pa.

Butler, Rev. Thomas P., 1922, Weston College, Weston, Mass.

Carroll, Anthony G., 1929, Weston College, Weston, Mass.

Cummings, William V., 1932, Ateneo de Manila, Manila, P. I.

Doino, Rev. Francis D., 1930, Woodstock College, Woodstock, Md.

Ecker, Anthony I., 1931, St. Peter's High School, Jersey City, N. J.

Gisel, Rev. Eugene A., 1925, Canisius High School, Buffalo, N. Y.

Gorman, Rev. Lawrence C., 1926, Woodstock College, Woodstock, Md.

Hauber, Edward S., 1929, Woodstock College, Woodstock, Md.

Hohman, Rev. Arthur J., 1922, St. Peter's College, Jersey City, N. J.

Ketcher, William L., 1932, Holy Cross College, Worcester, Mass.
Landrey, Gerard M., 1930, Holy Cross College, Worcester, Mass.
Langguth, Rev. Aloysius B., 1924, Holy Cross College, Worcester, Mass.
MacLeod, Rev. Henry C., 1924, Winchester Park, Kingston, Jamaica, B. W. I.
McCullough, Rev. Henry B., 1923, Ateneo de Manila, P. I.
McGuinn, Albert F., 1931, Fordham University, New York City.
Molloy, Joseph J., 1929, Woodstock College, Woodstock, Md.
Moynihan, Joseph J., 1930, Weston College, Weston, Mass.
Muenzen, Rev. Joseph B., 1923, Fordham University, New York City.
Power, Rev. Francis W. Power, 1924, Fordham University, New York City.
Schmitt, Rev. Richard B., 1923, Loyola College, Baltimore, Md.
Strohaver, Rev. George F., 1922, Georgetown University, Washington, D. C.
Sullivan, Rev. Joseph J., 1923, Boston College, Boston, Mass.
Tivnan, Rev. Edward P., 1923, Boston College, Boston, Mass.
Wolff, Rev. Edmund J., 1926, Weston College, Weston, Mass.

MATHEMATICS SECTION

Officers

Chairman, Rev. Joseph P. Merrick, Holy Cross College, Worcester, Mass.
Secretary and Sub Editor of Bulletin, J. Austin Devenny, Boston College, Boston, Mass.

Members

Barry, Rev. Thomas D., 1926, St. Andrew-on-Hudson, Poughkeepsie, N. Y.
Berry, Rev. Edward B., 1922, Georgetown Preparatory School, Garrett Park, Md.
Carasig, Rev. Paul M., 1923, Cagayan, Oriental Misamis, Mindanao, P. I.
Cusick, William H., 1928, Weston College, Weston, Mass.
Dawson, Rev. James F., 1922, St. Joseph's High School, Philadelphia, Pa.
Deppermann, Rev. Charles E., 1923, Manila Observatory, Manila, P. I.
Devenny, J. Austin, 1932, Boston College, Boston, Mass.
Doucette, Rev. Bernard F., 1925, Boston College High School, Boston, Mass.
Duross, Thomas A., 1932, Woodstock College, Woodstock, Md.
Dutram, Francis B., 1931, Holy Cross College, Worcester, Mass.
Fry, Leo F., 1926, Woodstock College Woodstock, Md.
Fitzgerald, Paul J., 1930, Canisius High School, Buffalo, N. Y.
Gipprich, Rev. John L., 1922, Georgetown University, Washington, D. C.
Kelley, Rev. Joseph M., 1922, Loyola High School, Baltimore, Md.
Kennedy, Rev. William W., 1923, Winchester Park, Kingston, Jamaica, B. W. I.
Logue, Rev. Louis R., 1923, Holy Cross College, Worcester, Mass.
Long, Rev. John J., 1924, St. Andrew-on-Hudson, Poughkeepsie, N. Y.
McCormick, Rev. James T., 1923, Weston College, Weston, Mass.
McGowan, George P., 1928, Woodstotck College, Woodstock, Md.

McLaughlin, Rev. Thomas L., 1923, Winchester Park, Kingston, Jamaica, B. W. I.

McNally, Rev. Paul A., 1923, Georgetown University, Washington, D. C.

Merrick, Rev. Joseph P., Holy Cross College, Worcester, Mass.

Murray, Joseph L., 1928, Weston College, Weston, Mass.

Nuttall, Rev. Edmund J., 1925, St. Andrew-on-Hudson, Poughkeepsie, N. Y.

O'Callaghan, Joseph T., 1929, Weston College, Weston, Mass.

O'Donnell, Rev. George A., 1924, St. Louis University, St. Louis, Mo.

O'Laughlin, Rev. Francis D., 1923, Fordham University, New York City.

Phillips, Very Rev. Edward C., 1922, 501 East Fordham Road, New York City.

Quigley, Rev. Thomas H., 1925, Loyola High School, Baltimore, Md.

Repetti, Rev. William C., 1922, Manila Observatory, Manila, P. I.

Roth, Rev. Albert C., 1923, Canisius High School, Buffalo, N. Y.

Roth, Rev. Charles A., 1923, St. Andrew-on-Hudson, Pougkkeepsie, N. Y.

Smith, Rev. John P., 1923, St. Peter's College, Jersey City, N. J.

Sheehan, William D., 1928, Weston College, Weston, Mass.

Sohon, Rev. Frederick W., 1924, Georgetown University, Washington, D. C.

Sweeney, Joseph J., 1930, Boston College High School, Boston, Mass.

Wessling, Rev. Henry J., 1923, Boston College High School, Boston, Mass.

PHYSICS SECTION

Officers

Chairman, Rev. William G. Logue, Weston College, Weston, Mass.

Secretary and Sub-Editor of Bulletin, Lincoln J. Walsh, Loloya College, Baltimore, Md.

Members

Berry, Rev. Edward B., 1922, Georgetown Preparatory School, Garrett Park, Maryland.

Brock, Rev. Henry M., 1922, Weston College, Weston, Mass.

Brock, Lawrence M., 1930, Weston College, Weston, Mass.

Crawford, Rev. William R., 1924, Boston College High School, Boston, Mass.

Crotty, Rev. Edward M., 1932, St. Peter's College, Jersey City, N. J.

Daley, Rev. Joseph J., 1930, Boston College High School, Boston, Mass.

Dawson, Rev. James F., 1923, St. Joseph's High School, Philadelphia, Pa.

Delaney, Rev. John P., 1923, Canisius College, Buffalo, N. Y.

Deppermann, Rev. Charles E., 1923, Manila Observatory, Manila, P. I.

Doherty, Joseph G., 1930, Weston College, Weston, Mass.

Doucette, Rev. Bernard F., 1925, Boston College High School, Boston, Mass.

Dowd, Rev. Austin V., 1930, Woodstock College, Woodstock, Md.

Dutram, Francis B., 1931, Holy Cross College, Worcester, Mass.

Fey, Leo F., 1926, Woodstock College, Woodstock, Md.

Frohnhoefer, Rev. Frederick R., 1926, St. Francis Xavier High School, New York City.

Gipprich, Rev. John L., 1922, Georgetown University, Washington, D. C.

Guicheteau, Armand J., 1932, Ateneo de Manila, Manila, P. I.
Hearn, Rev. Joseph R., 1925, St. Andrew-on-Hudson, Poughkeepsie, N. Y.
Heyden, Francis J., 1931, Manila Observatory, Manila, P. I.
Kolkmeyer, Rev. Emeran J., 1922, Georgetown University, Washington, D. C.
Linehan, Daniel, 1931, Holy Cross College, Worcester, Mass.
Loeffler, James D., 1929, Weston College, Weston, Mass.
Logue, Rev. William G., 1923, Weston College, Weston, Mass.
Love, Rev. Thomas J., 1923, Loyola College, Baltimore, Md.
Lynch, Rev. J. Joseph, 1925, Fordham University, New York City.
Mahoney, Rev. James B., 1925, St. Joseph's College, Manila, P. I.
McGowan, George P., 1928, Woodstock College, Woodstock, Md.
McGrath, Philip H., 1932, Georgetown University, Washington, D. C.
McKone, Peter J., 1931, Boston College, Boston, Mass.
McNally, Rev. Herbert P., 1922, Canisius High School, Buffalo, N. Y.
Merrick, Rev. Joseph P., 1923, Holy Cross College, Worcester, Mass.
Miley, Rev. Thomas H., 1923, 980 Park Avenue, New York City.
Miller, Walter J., 1931, Georgetown University, Washington, D. C.
Moore, Rev. Thomas H., 1923, St. Joseph's College, Philadelphia, Pa.
Murray, Joseph L., 1928, Weston College, Weston, Mass.
Nuttall, Rev. Edmund J., 1925, St. Andrew-on-Hudson, Poughkeepsie, N. Y.
O'Callahan, Joseph T., 1929, Weston College, Weston, Mass.
O'Conor, Rev. John S., 1928, Woodstock College, Woodstock, Md.
O'Laughlin, Rev. Francis D., 1923, Fordham University, New York City.
Phillips, Very Rev. Edward C., 1922, 501 E. Fordham Road, New York City.
Quigley, Rev. Thomas H., 1925, Loyola High School, Baltimore, Md.
Rafferty, Rev. Patrick, 1923, Loyola High School, Baltimore, Md.
Reed, Francis G., 1932, Brooklyn Preparatory School, Brooklyn, New York.
Rohleder, Charles H. J., 1931, Woodstock College, Woodstock, Md.
Roth, Rev. Albert C., 1923, Canisius High School, Buffalo, N. Y.
Roth, Rev. Charles A., 1923, St. Andrew-on-Hudson, Poughkeepsie, N. Y.
Sheehan, William D., 1928, Weston College, Weston, Mass.
Smith, Rev. John P., 1923, St. Peter's College, Jersey City, N. J.
Smith, Rev. Thomas J., 1932, Weston College, Weston, Mass.
Sullivan, Rev. Daniel H., 1923, 45 Cooper Street, Boston, Mass.
Tobin, Rev. John A., 1923, Boston College, Boston, Mass.
Tynan, Rev. John G., 1926, Woodstock College, Woodstock, Md.
Walsh, Lincoln J., 1931, Loyola College, Baltimore, Md.
Welch, Leo G., 1932, Woodstock College, Woodstock, Mass.